

Quick Recap:
Which shoe exerts more
pressure? Why?



(pg. 424 text)

What happened to the
submarines?



Key Vocabulary

Vocabulary Bank

- atmospheric pressure
- standard atmospheric
- pressure (SAP)
- Boyle's law

Pressure Units

Pressure UNITS of MEASUREMENT (at sea level)
760.00mmHg = 760.00 torr = 1.0000 atm = 101.33 KPa = 14.7 psi

Ex. Find the value of 750.0-mm Hg atmospheric pressure in atm

Given:

Required:

Analyze it:

(DEMO)The Cartesian Diver

Discussion Questions

1. When you squeezed the bottle, what happened to the contents of the eyedropper?

What happened to the position of the eye dropper?

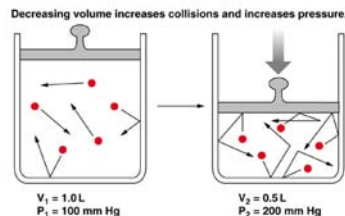
2. When you released the bottle, what happened to the contents of the eyedropper?

What happened to the position of the eyedropper?

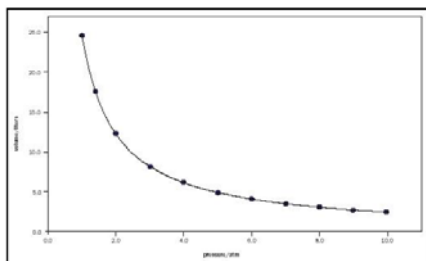


Pressure and Volume

- Robert Boyle determined the relationship between P and V in 1662
- Boyle's law : At constant temperature the volume of a gas is inversely proportional to the pressure.



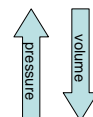
Pressure and Volume relationship



Making Predictions. Establishing a relationship.

- If the pressure is increased twice, what would you predict would happen to the volume?

Ref. pg 432 in textbook



Pressure and Volume Relationships (Cont)

General form for the equation of a straight line that passes through the origin of a graph $y = m x$

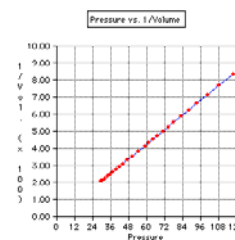
substituting $1/P$ (1/pressure) for x

V (volume) for y and k for m ...

$V = k (1/P)$ where k is a constant

Boyle's Law

- If we construct a graph of P versus $1/V$, we get a straight line, with a slope of k
- Since the slope of the line (k) is constant, and since the initial and final conditions are both equal to k , we can write..



Boyles Law

- Boyle determined that for the same **amount** of a gas at constant **temperature**, $p * V = \text{constant}$
- This defines an inverse relationship: when one goes up, the other comes down.

BOYLES LAW: $P_1 V_1 = P_2 V_2 = k$

- Boyle's Law can be used to predict the interaction of pressure and volume.
- Need to know 3 out of 4 variables.
- P_1 and V_1 are the pressure and the volume of the gas for the initial set of conditions
- P_2 and V_2 are the pressure and volume of the gas for the final set of conditions.

Plan your strategy...Act on Your Strategy

$$P_1 = \frac{P_2 V_2}{V_1}$$

$$V_1 = \frac{P_2 V_2}{P_1}$$

$$P_2 = \frac{P_1 V_1}{V_2}$$

$$V_2 = \frac{P_1 V_1}{P_2}$$

$$P_1 V_1 = P_2 V_2$$

Sample Problem: A weather balloon with a volume of 2.00×10^3 L at a pressure of 96.3 kPa rises to an altitude of 1.00×10^3 m, where the atmospheric pressure is measured at 60.8 kPa. Assuming there is no change in the temperature or amount of gas, what is the final volume of the weather balloon?

Applying Boyles Law

Step By step Approach

Required:

The final volume, V_2 , of the balloon after the pressure decreases

Given:

- - the initial pressure on the balloon, $P_1 =$
- - the initial volume of the balloon, $V_1 =$
- - the final pressure on the balloon, $P_2 =$
- - there is no change in temperature or amount of gas

Analysis:

Pressure and volume are changing at a constant temperature and amount of gas. Therefore, use the equation for Boyle's law.

Isolate the variable for final volume, V_2 . Divide each side of the Boyle's law equation by P_2 and isolate V_2

Solve:

Substitute the number and units for the known variables in the formula and solve. (Watch units!)

- The final volume of the balloon is _____

Other Examples

- 20.5 L of nitrogen at 25°C and 742 torr are compressed to 9.8 atm at constant T. What is the new volume?
- 30.6 mL of carbon dioxide at 740 torr is expanded at constant temperature to 750 mL. What is the final pressure in kPa?

Boyle's Law (Summarized):

- **At a constant temperature, the volume of a fixed mass of gas is inversely proportional to its pressure.**

☞ that is, if volume increases, pressure is reduced;

☞ if volume decreases, pressure increases

Homework: p. 434 #1-4 p. 435 #1-6